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ABSTRACT

This paper analyzes cross-sectional data compiled from Pennsylvania's 501 school districts to investigate which factors influence academic performance. It also examines these factors to determine whether increased spending is the key to improved academic performance. Topics addressed include teacher-student ratios, teacher salaries, and per pupil spending. Results indicate that per pupil spending and district enrollment levels have positive but very small effects on school academic performance. For example, each $1,000 increase in per pupil spending relates to a standardized score increase of only 5.8 points, less than one-half of one percent. Thus, simply raising spending is not a cost effective way to improve education. Certain community factors, including being in a metro district and the percentage of low income students enrolled, appear to exert negative influence. For every one percent increase in the proportion of low income students, the average standardized score decreases by 1.72 points. Results confirm that social factors play a more important role in determining the district's cost effectiveness performance. Though popular belief suggests that measures such as teacher-student ratios, teacher salaries, and higher per pupil spending are areas where policy needs to be directed, this paper finds no support for these beliefs. Variable definitions are appended. (Contains 23 footnotes.) (SM)

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EXPLAINING VARIABILITY IN SCHOOL PERFORMANCE: THE CASE OF PENNSYLVANIA

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Allegheny Institute Report #02-04
April 2002

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Key Findings

There is an ongoing debate amongst educators and policy makers regarding the factors that enhance academic performance. Three factors are at the forefront of this argument: class size, teacher salaries, and per pupil operating expenditures. According to recent studies across the country:

- There is no unambiguous statistical relationship between lower student-teacher ratios and academic performance. Even in studies that claim class size reductions improve student performance, the cost of such a policy heavily outweighs minimal improvements.

- Increasing teacher salaries will not cause an improvement in student performance. Teacher salaries explain less than 4 percent of the variation in student test scores. Advocates of such a policy claim that higher salaries reward quality teachers, but in some states teacher pay is not based on performance or merit. Therefore increasing salaries will reward both good and bad teachers and not provide a noticeable increase in academic performance.

- The latest research shows that per pupil spending nationwide rose 300 percent (adjusted for inflation) from 1965 to 1995 without a noticeable improvement in achievement test scores. There is no strong or consistent relationship between student performance measures and the bulk of school resources. In fact, researchers conclude that family and community factors have far greater influence on student performance than does per pupil spending.

The Allegheny Institute's analysis of Pennsylvania's 501 districts substantiates national findings. Our multiple regression analysis shows that:

- Per pupil spending and district enrollment levels have positive but very small effect on school academic performance. For example, each $1,000 increase in per pupil spending is associated with a PSSA score increase of only 5.8 points, less than one half of one percent. Thus, simply raising spending is not a cost effective way to improve education.

- Certain community factors, such as being in a metro district and the percentage of low income students enrolled, appear to exert negative influence. For every one percent increase in the proportion of low-income students, the average PSSA score decreases by 1.72 points.

- It is popularly believed that measures such as student-teacher ratios, teacher salaries, and higher per pupil spending are areas where policy needs to be directed. This paper finds no support for these popular misconceptions.

Introduction

Improving student performance seems to be the "Holy Grail" for educators everywhere. The education establishment, with the help of politicians, is not opposed to spending billions of dollars to find it. Countless studies have been conducted to assess which factors help achieve academic success. These studies have produced policies and programs designed to help children succeed in school. Most have met with little success. Per pupil spending has been steadily increasing while scores on student achievement tests have been on the decline for decades.

What can be done to reverse the trend? The current fad of academicians is to focus their search on a handful of variables: class size (student-teacher ratios); teacher salaries, and expenditures per student. The common thread of these factors is to increase spending on the school system. Taxpayers are required to dig deeper and deeper into their pockets to fund programs designed to add more teachers to the system, pay them more and build more classrooms in which to house them. The question to be asked by the taxpayer is simply this: Are we receiving a fair return for our tax dollars?

Is throwing more and more money at our public school system translating into better and better results? Some proponents say that more money helps and still more is needed. Others say that we are spending too much and after decades of declining academic performance are calling for radical changes to the system that range from academic accountability to school choice and privatization. Educational economist Eric Hanushek's research suggests that all schools in America are funded beyond a minimum level necessary for students to be successful. In fact, he suggests that the problem lies with the decision making process and how the money is spent. His research on other papers from around the country "does not suggest that resources never matter, nor does it suggest that resources could not matter. It only indicates that the current organization and incentives of schools do little to ensure that any added resources will be used effectively."[1]

The purpose of this paper is to analyze cross-sectional data compiled from the Commonwealth's 501 school districts to try and determine which factors influence academic performance. This will be done using a simple least squares regression method. Once identified, the factors will be examined to determine if increased spending is the key to improved academic performance or if another type of policy should be implemented.

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[1] Hanushek, Eric A. "Assessing the Effects of School Resources on Student Performance: An Update". Educational Evaluation and Policy Analysis. Summer 1997, Vol.19, No. 2, Pp. 141-164. Page 156.

Existing Research

Existing research devoted to identifying factors that influence student academic performance are legion. However, their focus lies predominantly with student-teacher ratios, teacher salaries, and increasing per-pupil expenditures. The following provides a brief summary of the findings of current literature.

Student-Teacher Ratios

Student teacher ratios are used to measure one-on-one time between the student and teacher. Based on the logic states that the more individual attention a student receives, the better their academic performance, some advocate more teachers in districts to lower this ratio. While this may be true for some individuals, should lower student-teacher ratios be universally applied throughout a given school district or even throughout all districts in the state?

This can be a very expensive policy to pursue. Average teacher salaries in Pennsylvania are approximately $46,000 per year. Consider a representative district with a total enrollment of 2,290 students and 118 classroom teachers. Their student-teacher ratio is 19.4. Suppose that district sets a new policy to reduce this ratio to 17.0. It will need to hire 17 more teachers (for a total of 135) to meet that goal, which would add nearly a million dollars to the district's annual payroll.[2] Then too, the district may need to build new classrooms in which to house this personnel expansion. Teacher salaries and building costs are the two greatest expenses in any district budget.

The simple example above shows that a policy to reduce student-teacher ratios can significantly raise district expenses. When aggregated statewide, it can cost taxpayers billions. In 1996, California instituted a policy to reduce class sizes for all students enrolled from kindergarten through 3rd grade. To achieve this goal, the state hired 60,000 new teachers at a cost of $8 billion. Are these policies providing improved academic performance?

The answer in California came from a consortium of researchers from the American Institutes for Research, RAND, Policy Analysis for California Education, WestED, and EDSource. After 6 years of monitoring the program, the researchers concluded that there is no relationship between statewide student achievement and the statewide classroom size reduction efforts.[3] The program did however, add 60,000 new members to the California Teachers Association, a strong advocate of reducing class sizes.

Studies from around the country have been unable to find a consistent positive relationship between smaller class sizes and improved academic performance. Eric Hanushek's paper, "Assessing the Effects of School Resources on Student Performance:

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[2] (2290/17.0)=135. 135-118=17. Salaries depend of course on degree level, experience, and location, urban or rural, of school district.

[3] The Education Intelligence Agency. Official Researchers Say Class Size Doesn't Matter In California. EIA Communique. February 11, 2002. Page 2. http://members.aol.com/educationintel

An Update", summarizes over 400 different studies and finds that there is no convincing evidence that smaller student-teacher ratios lead to better academic performance.[4] He notes that some teachers and students may indeed benefit from smaller class sizes, but the cost of such programs outweighs their effectiveness.

One group that found a statistically significant and positive relationship between lower student-teacher ratios and improved academic performance is the Texas Educational Excellence Project (TEEP) from Texas A&M University.[5] Researchers from TEEP found that a one student decrease in the average student-teacher ratio in each district would raise average achievement test scores about 1 percentage point over a five year period for all students (and about 2 percentage points for low income students).

In the simple example above, the district lowered its ratio by about 2 students (19.4:1 to 17:1). In 1999, the average score on the Pennsylvania statewide achievement test (PSSA) was 1313. Using the TEEP results, a decrease in the student-teacher ratio by 1 student would raise the score 13 points (and thus 26 points for a two student decrease). TEEP researchers noted that this increase in the achievement test score would take place over 5 years (about 3 points per year). Therefore our sample school district could spend millions of dollars in teacher salaries to raise its average test scores 26 points or 2 percent over a five year period.[6] Not a strong endorsement for class reduction programs.

One theory given for the ineffectiveness of class reduction programs is that teacher quality is too low. Are the teachers being added to the district to reduce student-teacher ratios of the same quality as the incumbents? Advocates of smaller class sizes claim that quality will remain constant. Opponents of the policy disagree, claiming that those teachers added to the system will be of lower quality, otherwise they would have already been in the schools. Hanushek finds that for small increases in classroom staff, quality is not much of an issue. However, if a district has to embark on a large-scale change, such as what happened in California, lower quality becomes a factor. It will be especially true in an area, or district, that already has a shortage of qualified teachers.

Teacher certifications are not always a guarantee of quality. Many states have lowered passing grades or standards to solve teacher shortages. In their article "Concerns About Pennsylvania Teacher Certification", authors Jake Haulk and Eric Montarti reported that nearly 50 percent of prospective teachers did not pass the following subject matter: chemistry; education in elementary school; home economics; mathematics; and Spanish. When confronted with these statistics, one state official suggested changing the exams so

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[4] Hanushek, Eric A. "Assessing the Effects of School Resources on Student Performance: An Update". Educational Evaluation and Policy Analysis. Summer 1997, Vol.19, No. 2, Pp. 141-164. Of the 400 studies evaluated, only 15% (60) found a statistically positive relationship between achievement and lower teacher-pupil ratios.

[5] The Texas Educational Excellence Project. "Class Size, Teacher Salaries, and Student Performance on the TAAS." Texas A&M University. January 1999. Pp. 1-35.

[6] Does not include costs to expand schools to accommodate more teachers.

more aspiring teachers could pass.[7] Hiring unqualified teachers will negate any positive gains that students may achieve with the lower student-teacher ratios.

What of the claims of increased one-on-one time as student-teacher ratios decrease? Frank Stephenson suggests that reducing class size only adds a few minutes per day of one-on-one time, which would be of marginal help to the students.[8] In his simple example he assumes that the school day consists of 6 hours of class time of which 3 hours are devoted to individual instruction. If there are 40 classes with 25 students, each student receives 7.2 minutes of individual instruction per day. If class sizes are reduced so that there are now 50 classes with 20 students, those students receive 9 minutes of one-on-one time per day. Will the additional benefit each student receives from this addition 1.8 minutes of one-on-one time per day greater than the cost of adding 10 new teachers to the payroll?

Policies to reduce student-teacher ratios are very popular with politicians, teachers and teachers' unions. Research by William Fagley shows that class size explains about 24 percent of the variation in state achievement scores.[9] However his evidence, as well as evidence from other research, suggests that the enormous costs of such policies outweigh the minimal benefits.

Teacher Salaries

Some education analysts claim that by increasing teacher salaries, the problem of unqualified teachers will be solved. The underlying assumption is that higher salaries will draw more persons (preferably with excellent teaching skills) into the profession. This theory would work well, and actually does work in the private sector, if teachers were paid based on quality or merit, as are private sector workers. Instead teacher salaries are based on factors such as years of experience and degree level, but not on effectiveness. Therefore, raising salaries not only rewards good teachers but rewards bad ones as well. The system is not designed to distinguish good teachers from the bad.

Do higher teacher salaries imply better academic performance? Eric Hanushek finds that there is virtually no relationship between teacher salaries and student performance because salaries are not performance based.[10] Salaries tend to increase whether or not academic performance improves. Most research has failed to find a strong positive

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[7] Haulk, Jake and Eric Montarti. "Concerns About Pennsylvania Teacher Certification". *Policy Brief.* Allegheny Institute for Public Policy. Volume 2, Number 8. February 18, 2002.

[8] Stephenson, E. Frank. "Reducing Class Sizes: Other Things Are Not Always Equal". *Ideas on Liberty.* Foundation for Economic Education. January 2002. Pages 25-27.

[9] Fagley, William L. "More Spending Not the Solution to School Woes". Mackinac Center for Public Policy. October 5, 1998. http://www.mackinac.org.

[10] Hanushek, Eric A. "The Truth About Teacher Salaries and Student Achievement". Hoover Institution Weekly Essay. Hoover Institute. April 3, 2000. Pp. 1-2. http://www-hoover.stanford.edu/pubaffairs/we/current/hanushek_0400.html.

statistical relationship between teacher salaries and academic performance. In fact, William Fagley finds that teacher salaries only explain approximately 3.5 percent of the variation in state achievement scores.[11]

Researchers at Texas A&M University's Texas Educational Excellence Project did conclude that teacher salaries are positively correlated to academic performance. They advocate higher teacher salaries because it would entice more qualified persons into the profession. This hypothesis leads them to the conclusion that better qualified teachers would improve the performance of the students. This relationship especially benefits low-income students. (While few would disagree with this assumption, they did not offer any suggestions on how to separate good teachers from the bad.) Based on their model of school districts in Texas, TEEP claims that a one-time increase of $1,000 in average salaries would produce a 2.12 percentage point increase in average state achievement scores over a five-year period (0.42 percent per year). For low-income students the average increase would be 3.7 percent over five years (0.74 percent per year).[12] Again this is another policy where the enormous costs of increasing teacher salaries would overshadow the minimal gains in student achievement.

Even though the TEEP study found a statistically significant positive relationship between teacher salaries and academic performance, the relationship is very small. Overall most current research shows that there is no definite or appreciable relationship between teacher salaries and student performance.

Per Pupil Spending

Many educational advocates claim that increasing per pupil spending will lead to improved academic achievement. This theory claims that if students have more and better resources at their fingertips, they will perform better. However, Eric Hanushek's research finds that per pupil spending has risen 300 percent from 1965 to 1995 (in 1996-97 dollars) without a noticeable improvement in achievement test scores. In fact he reviews over 400 different studies and concludes that there is no strong or consistent relationship between student performance measures and variations in school resources.[13]

This notion is reinforced by Bagley who also finds that student achievement has very little to do with spending levels. His research shows that less than 5 percent of the variation in state achievement scores is explained by a district's per pupil spending level.[14] Bagley concludes that the factors that are most likely to explain academic performance are non-school factors such as family and community background.

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[11] Fagley. Pg. 1.

[12] The Texas Educational Excellence Project. "Class Size, Teacher Salaries, and Student Performance on the TAAS." Texas A&M University. January 1999.

[13] Hanushek, Eric A. "Assessing the Effects of School Resources on Student Performance: An Update". Educational Evaluation and Policy Analysis. Summer 1997, Vol.19, No. 2, Pg. 141.

[14] Bagley. Page 1.

Hanushek discovers that studies, which rely on aggregating data to the state level, tend to find a more statistically significant and positive relationship between per pupil spending and academic performance. "Simply put, analyses at higher levels of aggregation are noticeably more likely to conclude that added resources improve student performances."[15] State-to-state comparisons can be misleading because, with the exception of Hawaii, all states delegate funds and (most of) the decision-making processes to the individual districts within the state. Therefore even though the state determines general rules and guidelines that the districts must follow, each district has a certain level of autonomy that cannot be accounted for with state-to-state regression analysis. Hanushek concludes, "(t)here is little reason to be confident that simply adding more resources to schools as currently constituted will yield performance gains among students."[16]

One such study that did find a statistically significant positive relationship between per pupil spending and achievement was conducted by RAND and released with much fanfare in 2000.[17] RAND's researchers used the National Assessment of Educational Progress (NAEP) scores of 44 states over a 7-year period.[18] RAND's researchers found that if a state raised its average per pupil spending by $1,000, then it could see a 2 percentage point increase in average NAEP scores. As pointed out above, this study compares state-to-state and ignores changes and policies at the district level. Because of this, the RAND results were met with skepticism in the academic community. Even if RAND's results were implemented through policy it would be very expensive and yield minimal results.

Current research focuses on three main areas: student-teacher ratios, higher teacher salaries, and spending per pupil. Although some research does find that increasing spending in these areas will cause greater levels of academic improvement, the results will be minimal and the cost of implementing such policies outweighs the benefits.

Statistical Analysis of Pennsylvania School Performance

In October 2001, Standard and Poor's School Evaluation Services (SES) released the first comprehensive data compilation of Pennsylvania's 501 school districts.[19] SES includes over 1,500 pieces of information for every district. The data includes district demographics, student performance results (PSSA, SAT, and ACT scores), and district information (number of teachers, students, and buildings), as well as financial information (operating expenditures per pupil, average teacher salaries, and revenue sources). This data accumulation allows, for the first time, researchers to analyze

[15] Hanushek. 1997. Page 145.
[16] Ibid. Page 148.
[17] Grissmer, David W., Ann Flanagan, Jennifer Kawata, and Stephanie Williamson. "Improving Student Achievement: What NAEP State Test Scores Tell Us." RAND 2000.
[18] NAEP test is a national test administered to 12th grade students to check proficiency in math. Only 44 states volunteered to participate in the study (fluctuated between 35 and 44).
[19] www.ses.standardandpoors.com. One district did not participate.

Pennsylvania's school districts in a very thorough way. This section provides an analysis of factors that theoretically could affect student academic performance.

SES used per student operating expenditures and academic performance data to calculate a district's Performance Cost Index or PCI score. The PCI is calculated for each of the standardized exams taken by students (PSSA, SAT, and ACT). It is calculated by dividing per student operating expenditures by the district's average exam score, and then dividing that result by the exam's participation rate. Thus, the PCI is an "inverse" index, in that low PCIs indicate good performance. It is used to compare cost-performance between districts.

For purposes of this paper, the performance indicator to be examined is the Pennsylvania System of Scholastic Assessment (PSSA) test, which is administered to all students in grades 5, 8 and 11. Unlike the SAT or ACT, the PSSA is mandatory. In 1999 Pennsylvania districts reported that on average, 93.5% of students in these grades took the exam. Subsequently, the PCI index used in our analysis is based on average PSSA scores.

The explanatory variables are: operating expenditures per student; percentage of low income students; enrollment; average teacher salary; students per classroom teacher; and two dummy variables--one designating whether or not the district is located in a metro area and one to indicate if the district gives its teachers the option of joining a union. All of the variables used in these analyses are formally defined in the Appendix.

Districts Segmented into Spending Ranges- All Districts

The following table separates the districts into ten spending ranges.

Range	Number of Districts	Average Operating Expenditures	Average PSSA Score	Average PSSA Participation (%)	Average Low Income (%)	Average Enrollment	Average PCI	Average Class Size	Average Teacher Salaries
4,000-4,999	1	$ 4,777	1326	94.0	28.0	3,446	15.57	18.5	$ 35,017
5,000-5,999	23	$ 5,804	1322	94.5	21.2	2,877	19.23	18.6	$ 43,034
6,000-6,999	229	$ 6,562	1305	94.0	27.0	2,939	23.38	17.2	$ 44,466
7,000-7,999	154	$ 7,416	1311	93.0	29.0	4,186	26.89	16.2	$ 45,704
8,000-8,999	55	$ 8,414	1327	92.7	23.5	3,721	29.64	15.9	$ 51,368
9,000-9,999	22	$ 9,400	1322	93.0	28.1	6,657	38.18	15.9	$ 56,148
10,000-10,999	10	$ 10,290	1363	92.7	19.7	3,158	39.11	14.7	$ 56,880
11,000-11,999	4	$ 11,753	1362	94.3	26.3	1,715	35.55	14.3	$ 54,266
12,000-12,999	1	$ 12,324	1450	94.3	3.9	6,268	29.06	13.5	$ 64,336
13,000-13,999	1	$ 13,170	1445	94.2	4.3	2,939	31.42	12.0	$ 63,528
State Averages	*500*	*$ 7,256*	*1313*	*93.5*	*26.8*	*3,572*	*26.03*	*16.7*	*$ 46,440*

A plurality of districts (46%) fall into the $6,000-6,999 range while 31% falls in the $7,000-7,999 range. Only 16 (3%) districts spent above $10,000 (two above $12,000), while 24 (5%) of the districts spend less than $6,000 per pupil.

There does not appear to be an unambiguous positive relationship between levels of spending and average PSSA scores. Districts spending from $4,000 to $9,999 per pupil have similar average scores. The scores have a high of 1327 (at $8,000-8,999) to a low

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of 1305 (at $6,000-6,999). The overall state average is 1313. Districts spending between $10,000 and $11,999 did perform better on average (1362-1363). However, the two districts (from suburban Philadelphia) spending above $12,000 did very well on the average (1445-1450). These results are consistent with the hypothesis that per-pupil spending and academic achievement are not strongly related (on a scale of 0 to 1, the correlation coefficient is only 0.101). Furthermore, there is no definitive relationship between levels of per pupil spending and the percentage of low-income students in the district. With the exception of the top two districts, in terms of spending and PSSA scores, the percentage of low-income students shows little variation.

Average class size decreases as average operating expenditures increases. There is a strong negative correlation (-0.515) between the two variables, which substantiates the argument that districts are spending more money on teachers to reduce student teacher ratios. However, districts are not necessarily seeing a corresponding increase in PSSA scores. There is a weak, (negligible) negative correlation between PSSA scores and class size (-0.012).

Average teacher salaries increase as average operating expenditures increase. The strong positive correlation between the two variables (0.557) is not surprising because one of the largest (if not the largest) spending components for a district is teacher salaries. There is a $13,846 difference ($56,880-$43,034) between districts in the $5,000-5,999 range and the $10,000-10,000 range.

Districts Segmented into Spending Ranges- Selected Districts

One of the difficulties with large data sets is the presence of outliers. To obtain a better assessment of the relationships between variables, the data set was truncated to eliminate any district with an average PSSA score above 1400 and below 1200. This procedure removed 50 districts from the sample. The following table illustrates these results.

Range	Number of Districts	Average PSSA Score	Average Operating Expenditures	Average Low Income (%)	Average Enrollment	Average PCI	Average Class Size	Average Teacher Salaries
4,000-4,999	1	1326	$4,777	28.0	3,446	15.57	18.5	$35,017
5,000 -5,999	23	1322	$5,804	21.2	2,877	19.2	18.6	$43,034
6,000 -6,999	222	1306	$6,824	26.2	2,799	24.3	16.7	$44,643
7,000 -7,999	145	1315	$7,596	28.1	2,767	26.3	16.1	$46,553
8,000 -8,999	41	1307	$8,543	26.3	3,261	30.7	16.2	$51,540
9,000 -9,999	12	1331	$9,495	27.1	7,771	31.8	16.1	$57,678
10,000 -10,999	3	1340	$10,085	27.4	4,292	33.5	14.6	$55,752
11,000 -11,999	3	1347	$11,754	33.3	2,084	37.4	14.9	$52,848

The table above indicates that even though the upper and lower performing districts were removed from the data set, there still is no clear correlation between the spending ranges and average PSSA scores. The scores decline as average operating expenditures increases from $4,000 to $8,999. After $9,000, scores start to increase (24 points from

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the $8,000 level) but at a decreasing rate. In moving from the $5,000-5,999 level to the $10,000-10,000 level improves average PSSA scores 18 points or 1.5 percent.

Not surprisingly, average teacher salaries increase as the spending levels increase. This is largely due to the fact that teacher salaries are one of the largest components of a district's operating budget. However, salaries peak in the $9,000-9,999 range and then decrease in the final two upper ranges.

Student-teacher ratios decline as spending ranges increase. In the lower spending range, the average student-teacher ratio is 18.5 while in the upper spending range it is 14.9. This would support the argument that districts are spending more to increase the number of classroom personnel. However, average student enrollment does not show a steady increase. The lack of a steady increase in enrollment levels as spending levels increase indicates that districts may not necessarily be using the extra money on additional classroom teachers.

Regression Results--PSSA as the Dependent Variable

Using the truncated data set, an attempt was made to find which variables could best predict average PSSA scores. Variables that account for the learning environment such as per pupil spending, enrollment, student-teacher ratios, and teacher salaries, as well as variables that proxy community structure (percentage of low income students, whether or not the district is located in a metro area, and whether or not the district gives their classroom personnel the option of joining a union). Using a least squares method, all of the variables were regressed on PSSA. The determining factor is the t-stat ($t_{critical} = 1.96$ for a 95% confidence level). After the first regression, the variable with the lowest level of significance was eliminated and the process repeated, until all remaining explanatory variables were significant. The following table shows the combination of variables that best explains variation in PSSA scores.

Variable	Coefficient	T-stat
Intercept	1313.08	110.73
District Per-pupil Spending	0.0058	3.53
Percentage Low Income Students	-1.729	-16.13
Total District Enrollment	0.00145	2.19
District Located In Metro Area	-31.854	-2.5
Adjusted R2: 0.4050		

The adjusted R2 of the regression is 0.4050, indicating that the model is fairly effective at explaining variation in PSSA scores. The positive coefficients on per pupil spending and total enrollment mean that these variables will increase the average score. Each $1,000 increase in per-pupil spending will raise the average PSSA score by 5.8 points and for each 1,000 person increase in student enrollment, the score will increase by 1.5 points.

However, the negative coefficients on low-income students and the district metro dummy imply that these variables are associated with a decrease in a district's average PSSA

score. For every 1% increase in the percentage of low-income students, average PSSA scores decrease by 1.72 points. If the district is located in a metro area (population > 50,000), the average PSSA score falls by 31.8 points.[20]

It is interesting to note that two of the three variables that are touted in the national literature, average teacher salaries and student-teacher ratio, did not surface as significant in these regressions. In fact, when regressed one-on-one with PSSA scores, student-teacher ratios were not statistically significant. Therefore, the conclusion is that by themselves, policies focused on reducing student-teacher ratios or at increasing average teacher salaries will not be successful in increasing average academic achievement. The third variable, per pupil spending, was significant in these regressions, but the coefficient is very small. Therefore, any increases in per pupil spending are likely to result in only very small increases in achievement test scores.

Regression Results--PCI as the Dependent Variable

In this section, the districts will be analyzed through PCI scores. As noted above, PCI is a calculated performance index that represents the cost associated with a unit of measured educational performance, in this case the PSSA scores.[21] "On its own, the PCI reveals little about a district's overall return on resources. However, when a district's PCIs are compared with the PCIs of comparison groups, a better understanding of the relationship between spending and student results emerges."[22]

PCIs were regressed using the truncated data set on the variables that measure school inputs (per pupil spending, enrollment, student teacher ratios, and teacher salaries) as well as variables that measure community characteristics (percentage of low income students, whether or not they are located in a metro area, and whether or not they give their classroom personnel the option of joining a union). Using the same methodology as above, variables that were statistically insignificant (t_{actual} <1.96) at the 95% confidence interval, were removed from the equation. The following table summarizes the results.

Variable	Coefficient	T-stat
Intercept	-2.12	-1.73
District Per-pupil Spending	0.0031	18.45
Percentage Low Income Students	0.177	16.23
District Located In Metro Area	4.29	3.84
Adjusted R2: 0.6078		

An adjusted R2 of 0.6078 indicates that this regression provides a substantial explanation of variation across district PCIs. The variables that were statistically significant contributors to a district's PCI are per pupil spending, the percentage of low-income students enrolled in the district, and its location (metro vs. non-metro). Two of the three variables are community factors, which are largely beyond the control of the district.

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[20] In the truncated data set 9 districts were located in areas with more than 50,000. In the full set 16.
[21] Ibid. Glossary. Letter P, page 15.
[22] Ibid.

Keeping in mind that a smaller PCI is preferred, the three variables all "negatively" contribute to PCI. The resulting equation for approximating a district's PCI:

PCI = -2.12 + 0.0031(per pupil spending) + 0.177*(% low income students) + 4.29*(metro dummy)*

Consider a district with average per pupil spending of $7,500; average percentage of low income students of 29%; and is located in a metro district. This district's predicted PCI would be:

PCI = -2.12 + 0.0031($7,500) + 0.177*(29) + 4.29*(1) = 30.55.*

If the district were not located in a metro area, its predicted PCI would be 26.26, which is approximately the overall state average.

It is interesting to note that the academic variables, enrollment, student teacher ratios, and teacher salaries were not significant in determining a district's PCI. Again this finding is consistent with existing literature, which claims that policies to reduce student-teacher ratios and increasing teacher salaries are ineffectual. The coefficient on per pupil spending is positive which means that spending increases cost at a rate that is far greater than student performance increases.

Conclusion

In the preceding pages, an attempt was made to find the factors that influence student performance. Popular policy is geared toward implementing measures that increase spending in public schools. This is done through directly raising teacher salaries or indirectly through adding more teachers in an effort to reduce student-teacher ratios. Previous studies from around the country conclude that neither of these actions has a significant influence on academic performance. Overall per pupil spending has been shown to have a positive impact on academic performance, but it requires large amounts of spending in order to realize minimal academic gains.

The release of very detailed data from Pennsylvania's 501 school districts provided a unique opportunity to examine which factors affect student, as well as district, performance. To assess student performance, PSSA scores were regressed on variables that proxy school activity (per pupil spending, enrollment, student-teacher ratios, and teacher salaries) as well as variables that proxy community structure (percentage of low income students, whether or not they are located in a metro area, and whether or not they give their classroom personnel the option of joining a union).

The results were consistent with national literature. That is, academic variables such as student-teacher ratios and increased teacher salaries, although popular policies with teachers and politicians, do not have a significant impact on academic performance. The school related factors that influence achievement test scores are enrollment and per pupil spending. Both have a positive but very small relationship. Social factors such as the

percentage of low-income students and whether or not the district is located in a large metropolitan area, have a negative relationship with academic performance.

The next step was to analyze the how the same school activity and community data affects the district's overall performance. Regressing these variables against a district's Performance Cost Index (PCI) does this. The PCI is an "inverse" performance measure, such that the lower the PCI, the better the district's performance. The factors that are significant in determining a district's PCI are per pupil spending, percentage of low-income students, and whether or not they are located in a metro area.

The result of this regression also confirms that social factors play a more important role in determining the district's cost effective performance. Just as in determining student performance, the percentage of low-income students and whether or not a district is located in a metro area is key in determining PCI. The only school measure that affects PCI is per pupil spending. All three variables have an adverse affect on a district's PCI.

This paper attempts to determine which factors, school or community related, determine student and district performance. Although popular thinking claims that classroom measures such as student-teacher ratios, increasing teacher salaries, and increasing per pupil spending are the areas where policy is to be directed. This paper refutes the claims that such policies should be pursued. Neither student-teacher ratios nor teacher salary levels have any significant impact on academic performance. The only classroom measure that appears to be significant is per pupil spending. However, the relationship between academic performance and per pupil spending is very small. The cost of pursuing such policies would far and away exceed any benefit realized by the average student.

Recommendations based on the findings above would be that schools, particularly in poorer communities or with high percentages of children from troubled families, should focus on the basics. Make sure that all the time that is necessary be devoted to reading and mathematics. Instruction in social studies, self esteem, ecology, etc. could be set aside if need be. But reading and basic arithmetic must be mastered by the third grade. As a way of validating progress, PSSA exams should also be administered to third graders. If students do not have a mastery of reading and math in the early grades, the whole education process will be an exercise in futility.

Appendix

Variable Definitions[23]

Average Teacher Salary: The average teacher salary of the district's teaching staff. Calculated by dividing the total amount of salary expenditures by the total number of classroom teachers.

Enrollment: The number of individual students enrolled in the district. Includes in-district special education students.

Low-Income: The proportion of students deemed low-income in a school district. These students are individuals who are economically disadvantages and who may require special economic services and assistance in order to succeed. Data calculated by the Pennsylvania Department of Education.

Operating Expenditures (Per Pupil Spending): The amount spent on instruction, support services, and non-instructional services from the general fund, special revenue fund, food services, and other enterprise funds. Operating expenditures exclude capital and debt-related expenditures, adult education, community service, as well as trust and agency funds and internal service funds. For the purpose of this paper per pupil spending takes operating expenditures and divides by total enrollment.

Pennsylvania System of School Assessment (PSSA): The PSSA is a test administered statewide and provides data in a wide range of curricular areas to determine academic achievement; help schools further identify strengths and weaknesses; and foster improvement in academic programs. Unless excused by their parents, all fifth, eighth, and eleventh grade students are tested in reading and mathematics. Data source: Pennsylvania Department of Education.

Performance Cost Index--PSSA Composite: In analytical terms, a PCI represents the cost associated with a unit of measured educational performance, in this case the average excelling rate on the PSSA exam. The PCI is a "reverse" index; that is, lower PCIs can generally be viewed as more favorable than higher PCIs, since it represents the cost of educational performance. On its own, the PCI reveals little about a district's overall return on resources. However, when a district's PCIs are compared with the PCIs of comparison groups, a better understanding of the relationship between spending and student results emerges. Formula: Calculated by dividing per-student operating expenditures by the PSSA composite excelling rate, and dividing the result by the PSSA participation rate.

Student-Teacher Ratio (Class Size): The number of total enrollment students per classroom teacher. Classroom teachers are professional personnel who provide instruction to students in kindergarten through 12th grade or in ungraded classes.

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[23] http://www.ses.standardandpoors.com

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